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by

James V. Davis	Research Associate, Soil Chemistry
D. R. (Ron) Earhart	Research Associate, Vegetables
Vincent A. Haby	Associate Professor, Soil Chemistry
Allen T. Leonard	Research Assistant, Soil Chemistry
Elizabeth W. Neuendorff	Research Associate, Fruits
Gary H. Nimr	Technician II, Fruits
Miguel A. Palacios	Graduate Student, Roses
Kim D. Patten	Assistant Professor, Fruits
H. Brent Pemberton	Associate Professor, Roses
Stanley C. Peters	Formerly, Technician I, Fruits
William E. Roberson	Technician I, Roses
Ruth A. Taber	Research Scientist, Plant Pathology, College Station
Glenn C. Wright	Graduate Student, Fruits

Texas A&M University Agricultural Research
and Extension Center at Overton

Texas Agricultural Experiment Station
Texas Agricultural Extension Service

Overton, Texas

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INFLUENCE OF FERTILIZATION METHOD AND LIMING RATE ON PEACH TREE GROWTH AND SOIL pH

Kim Patten, Gary Nimr, and Elizabeth Neuendorff

INTRODUCTION

Fertigation, the application of water soluble fertilizer through a drip irrigation system, increases fertilizer efficiency, reduces labor costs and minimizes leaching losses (Kesner et al., 1985; Smith et al., 1979). Fertigation, however, reduces the soil volume to which fertilizer is added and therefore increases the potential for altered soil pH and chemistry in the wetting front. For example, fertigation of peaches with NH_4NO_3 in a sandy soil resulted in a decrease in soil pH from 6.2 to 4.5 and aluminum toxicity 6 months after initiation of fertigation (Edwards et al., 1982). The use of a non-acidifying N source like $CaNO_3$, or applications of fine limestone could alleviate the problem of acidification in the wetting zone. Data on acid sandy soils also indicate that urea is a less acidifying N source than NH_4NO_3 (Patten et al., 1988).

The objectives of this research were to 1) compare efficiency of N application with fertigation versus broadcast, 2) compare effect of different N sources in the fertigation system: $CaNO_3$ versus an NH_4 - N source (urea), 3) evaluate the use of lime to mitigate soil pH changes by fertigation with an acid forming N source.

MATERIALS AND METHODS

Treatments were applied to two-year-old 'Harvester' trees on Nemaguard rootstock. The experiment was a factorial arrangement of 3 fertilizer treatments by 3 lime rates, initiated in 1986. The three fertilizer treatments were: 1) broadcast of urea in April, May, and June at 5.3, 10.6, and 8.8 oz of N/tree/year for 1986, 1987, and 1988, respectively, 2) injection of urea at 60% the yearly broadcast N rate, or 3) injection of $CaNO_3$ at 60% the yearly broadcast N rate. The injection treatments were applied through a single emitter bi-monthly from April through September. The three rates of lime were 0, 2000, or 4000 tons/ac of 100 mesh limestone. There were ten single plant replications per treatment. The soil was a loamy sand, pH 5.5. Supplemental P, K, and Mg were broadcast applied to each tree at rates based on soil analysis. Trees were drip irrigated during the growing season at 5, 10, 15 gallons/day/tree in 1986, 1987, and 1988, respectively. Fertilizer was injected by displacement (Fig. 1). A two liter container with an inlet and outlet was placed at the base of each tree. An emitter was connected to the inlet line. Incoming water displaced the allotted fertilizer in the container. Trunk diameter was measured 8.5 in cm from the ground in the winter of 1986 and 1987. Trees were rated for vigor and leaf color during September 1986 and June 1988. Soil pH was measured from soil samples collected from the 0 to 8 in depth near the emitter. Frost precluded collection of yield data in 1987.

RESULTS

In 1986, trunk diameter was greater on fertigated trees than on those receiving broadcast N (Table 1). Plants fertigated with urea had greater trunk diameter when limed compared to no lime application. In 1987, there were no differences in trunk diameter between treatments. Plant vigor was increased by injected N compared to broadcast in 1986, but not in 1988. Leaf color was not affected by treatments in 1986 or 1988. Soil pH in the wetting zone from the 0 to 8 in depth was highest for injected $CaNO_3$ and lowest for broadcast and injected urea. Soil pH increased linearly with lime rate. After two years of fertilizer application, soil pH ranged from 4.9 for broadcasted urea and no lime to 6.5 for $CaNO_3$ with lime.

DISCUSSION

Based on the preliminary plant growth and soil pH data several observations can be made. First, in support of previous research on stone fruit, nitrogen can be supplied through the drip irrigation system at 60% the broadcast rate and result in comparable plant response (Smith et al., 1979; Kessner et al., 1984). This inference, however is speculative since there was no direct comparison of broadcast with injection at the same N rate. In some years when rainfall is high, leaching of broadcast N past the active root zone can occur within a very short time period. Fertigation should be very suitable under these conditions. Second, lime was able to reverse the trend for a rapid decline in soil pH due to the application of an acid forming N source in a small soil volume. The use of the more expensive, but base forming $CaNO_3$ would be an alternative to using a less expensive NH_4-N source plus liming. It would appear that $CaNO_3$ or a combination of $CaNO_3$ and urea would be the appropriate N source selection to fertigate peach trees on a poorly buffered soil. Although not statistically significant, soil pH was lower for broadcasted urea than injected urea. The rate of decline in soil pH is commensurate with the nitrification rate (Patten et al., 1988). The higher N rate applied with broadcast compared to injection could account for this lower soil pH despite the application over a larger surface area with broadcast than with injection.

It is too early in this experiment to gauge the long term effect of these treatments on peach tree productivity. It is expected, however, that factors resulting in a decline in rootzone pH below 5.6 will, over time, severely limit tree growth, yield, fruit size and tree longevity (Cummings, 1983; Edwards et al., 1982).

CONCLUSION

As expected, nitrogen source and liming markedly affected soil pH, but there was no major tree response to N source or lime rate after two years of treatment applications. These observations are in agreement with other studies that indicate N rates can be greatly reduced when injected through the trickle irrigation system.

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Table 1. Effect of nitrogen application method and liming rate on peach tree growth and soil pH.

Nitrogen application source-method	Lime rate (ton/ac)	Trunk diameter in 1986	Trunk diameter in 1987	Vigor[1] 1986	Vigor[1] 1988	Leaf Color[2] 1986	Leaf Color[2] 1988	Soil pH
Urea-Broadcast	0	13.8	36.2	3.4	3.7	3.5	3.9	4.9
	2000	11.8	34.6	3.1	4.3	3.2	4.0	5.4
	4000	13.0	35.8	3.4	4.5	3.7	4.1	5.7
Urea-Injected	0	13.0	36.2	3.7	4.3	3.6	4.2	5.3
	2000	15.7	36.6	3.6	4.3	3.8	4.1	5.8
	4000	15.4	37.4	3.9	4.1	3.8	3.9	6.0
$CaNO_3$-Injected	0	15.0	35.8	3.7	4.0	3.6	4.2	6.2
	2000	13.4	37.4	3.5	3.9	3.7	4.2	6.3
	4000	14.6	36.2	4.0	3.9	3.6	4.0	6.5
LSD @ 0.05%		2	2.8	0.5	0.7	0.4	0.6	0.6

1. Vigor rating on 1 to 5; 1 = dead, 5 = very high vigor.
2. Leaf color rating on 1 to 5; 1 = yellow, 5 = dark green.

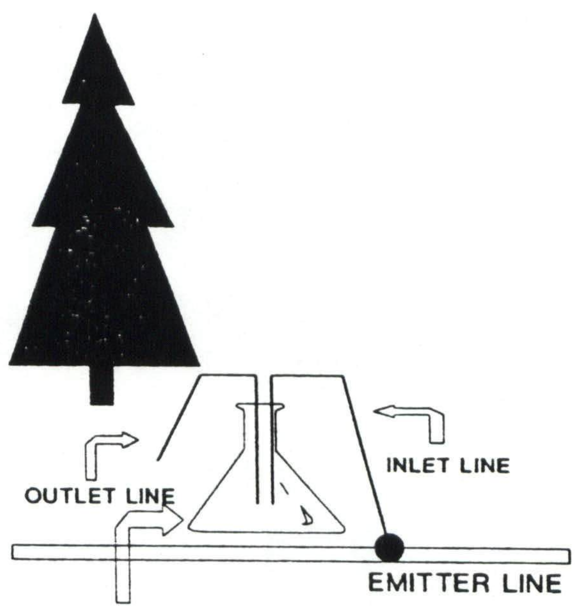

Figure 1. Diagram of fertigation method that allows injection of a specific treatment at an individual tree without the use of an additional drip line.